Computer Architectures: Introduction

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07.09.2022

Welcome to 2GA3

- What is this class about?
- Go to `www.menti.com` and enter number **1771 5615**
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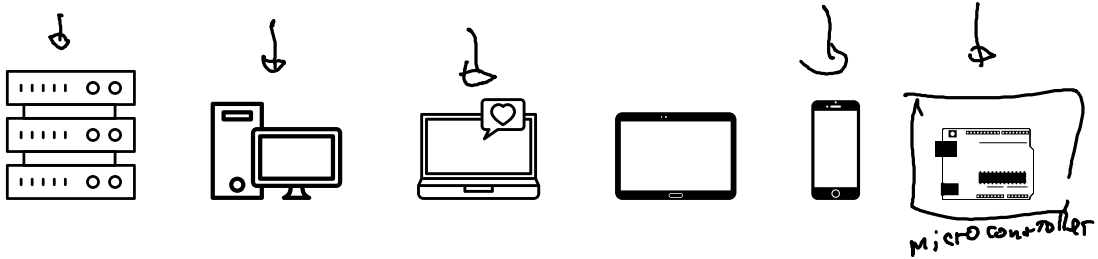
- Why should we care about architecture?



- When should we care about architecture?
  - High-performance computation
  - Operating systems
  - Drivers and hardware acceleration
  - Low-level and embedded programming

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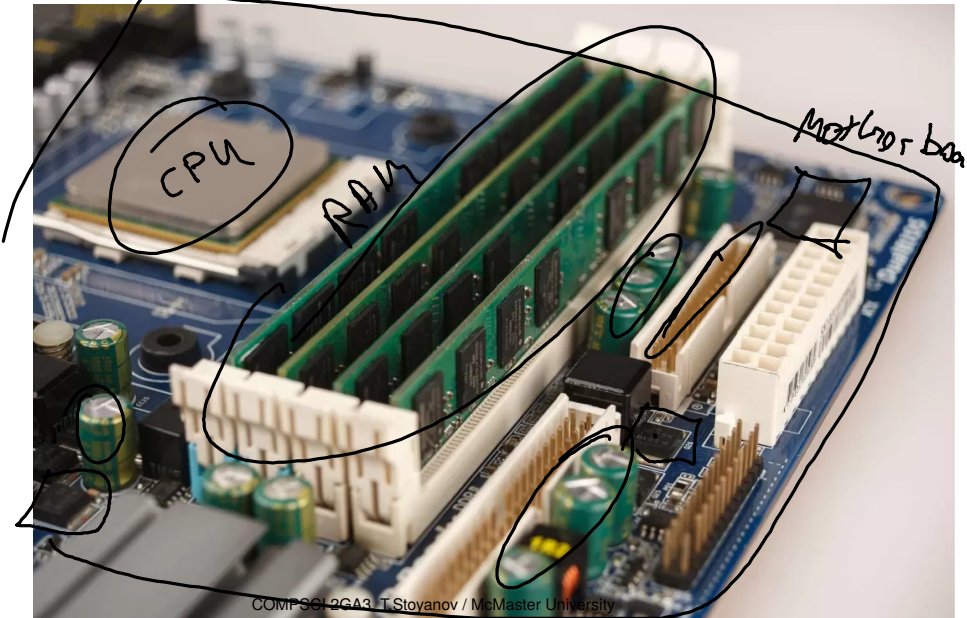
Components of a Computer



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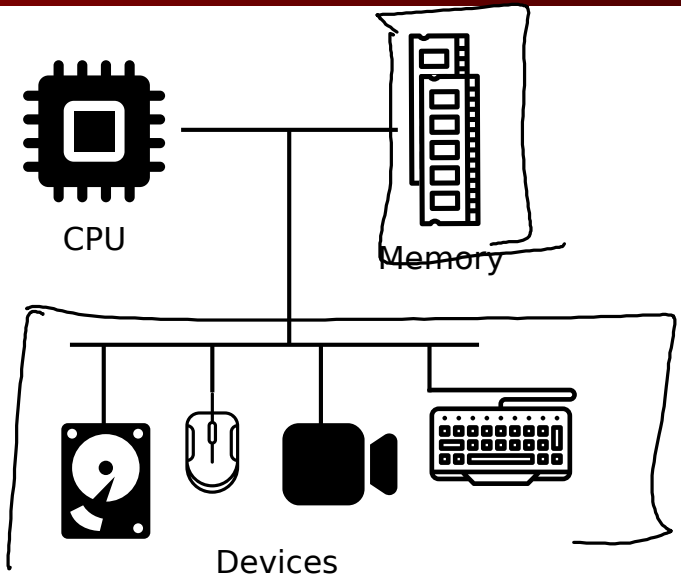
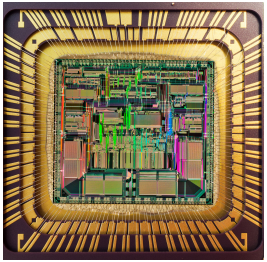


Architectural Design Principles

- How we combine components has implications on performance
- Task-dependent
- Core ideas of computer architecture and hardware design unchanged

Abstraction

- Abstraction in hardware design as key as it is in software
- Hides complexity
- Allows decisions and designs at different levels of detail



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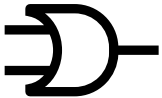

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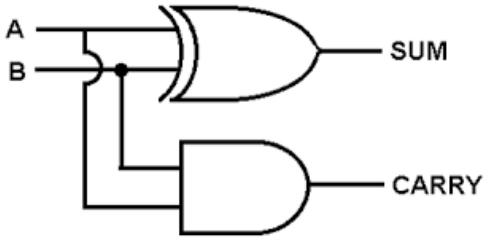

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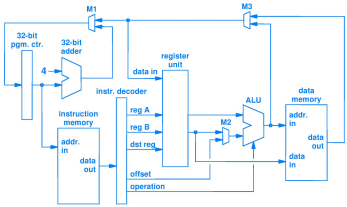
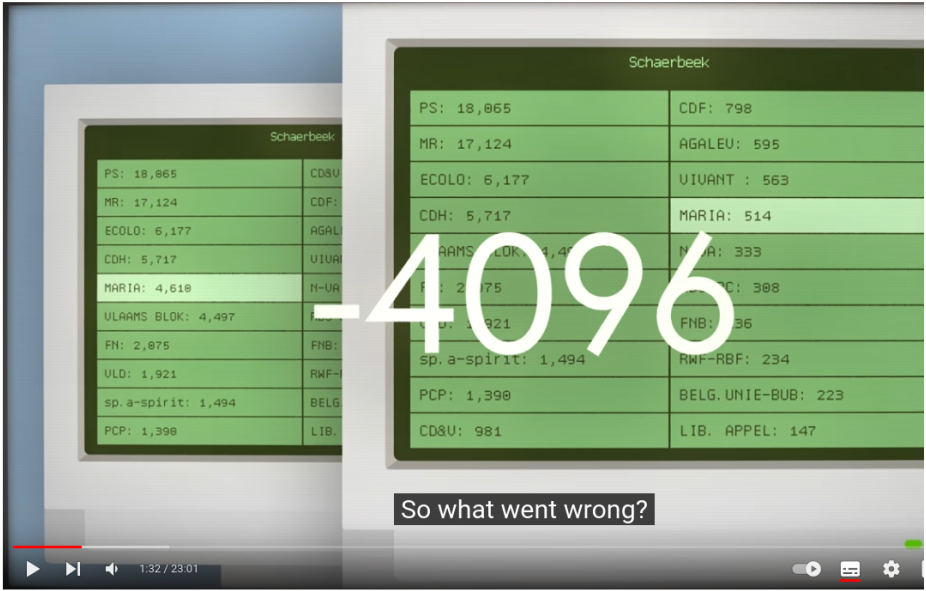


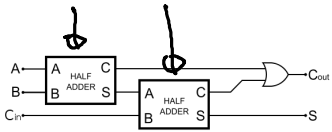
Figure 6.9 Illustration of data paths including data memory.

Redundancy and Replication



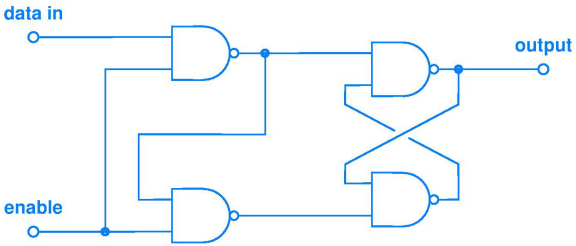
Redundancy and Replication

- Hardware has to *always* work as designed
- Formal verification of circuits
- Replication vs Iteration



Parallelism

- If an idea works once ...
- ... it can work 2^N times as well.
- Parallelism on a micro- and a macro-level.



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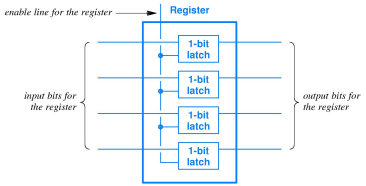

Figure 2.16 A 4-bit register formed from four 1-bit latches.

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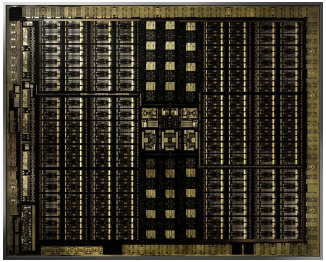
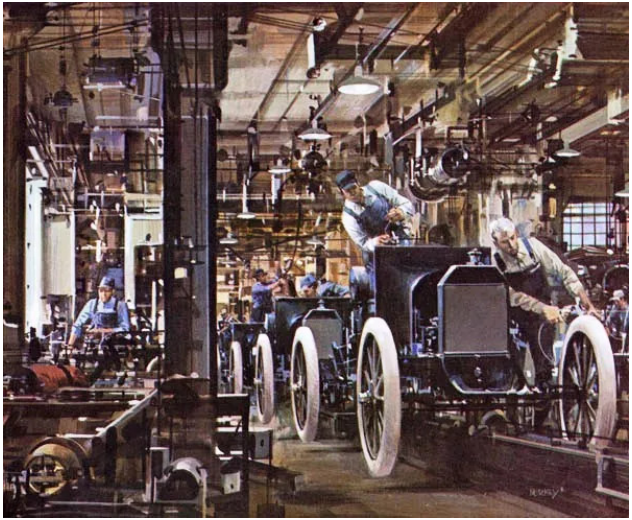
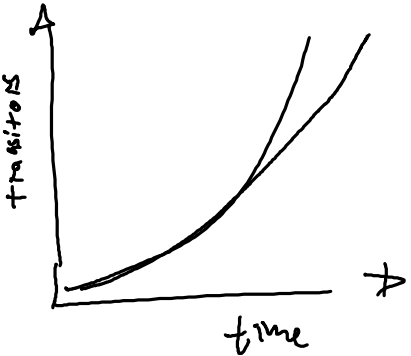


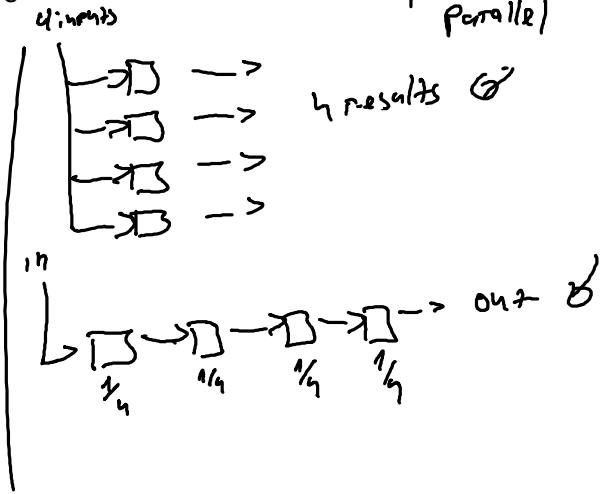
Pipelining



Moore's Law

- Get ahead of the curve so your design is not obsolete.





What will we learn this semester?

Topics we will cover:

- Digital logic basics
- Representing numbers and data
- Instruction Sets
- Pipelined processors
- Microcode and Macrocode
- Low-level programming languages
- Memory hierarchies
- Caching
- Virtual Memory
- Polling and Interrupts
- Device drivers and I/O

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ILOs

Knowledge and understanding of the following concepts:

- Basis of computation in digital logic;
- Representation of integer and floating point numbers;
- Interaction between processor, memory and I/O;
- Instruction representation and Instruction Set Architecture;
- Interaction between high- and low- level programming languages;
- The functions and implementation of pipelining and parallelism in the CPU;
- Virtual memory and caching;
- Programmed and interrupt-driven I/O.

ILOs

Skills and abilities to:

- Convert between different number representations and reason about representation standards;
- Program simple routines in ARM assembly;
- Interleave the use of assembly and C in a practical programming task;
- Interpret and reason about Instruction Set Architectures;
- Discuss and evaluate the design and performance of ISAs, memory hierarchies, and I/O systems;
- Design and evaluate architecture choices.

Administration

Grading

20% Homework Assignments [5 assignments]

30% Midterm Exam [November 3, TBC]

50% Final Exam

Tutorials

Monday 11:30—12:20 in ETB 238

Monday 09:30—10:20 in JHE A102

Monday 09:30—10:20 in JHE A101

Tuesday 12:30—13:20 in JHE A101

Note: Tutorial instructors may rotate due to conflicting schedules.

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Administration

- Academic integrity and other notes: check syllabus
- Health and safety: advised to wear a mask
- Echo360 recordings
- Online lectures, face-to-face tutorials
- Server access for homeworks

Meet the team

Todor Stoyanov

Bhuvesh Chopra

Angela Wang

Manish Rawat

Qi Zhao

A little about you

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